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FOREST PEST CONDITIONS IN THE ROCKY MOUNTAIN REGION FOR 1990

FOREST PEST CONDITIONS

IN THE

ROCKY MOUNTAIN REGION

1990

By

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August 1991

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The Forest Pest Management (FPM) Staff of the Timber, Forest Pest, and Cooperative Forestry Management Unit extends appreciation to all cooperators who contributed to this report. The cover was designed by Curtis O'Neil.

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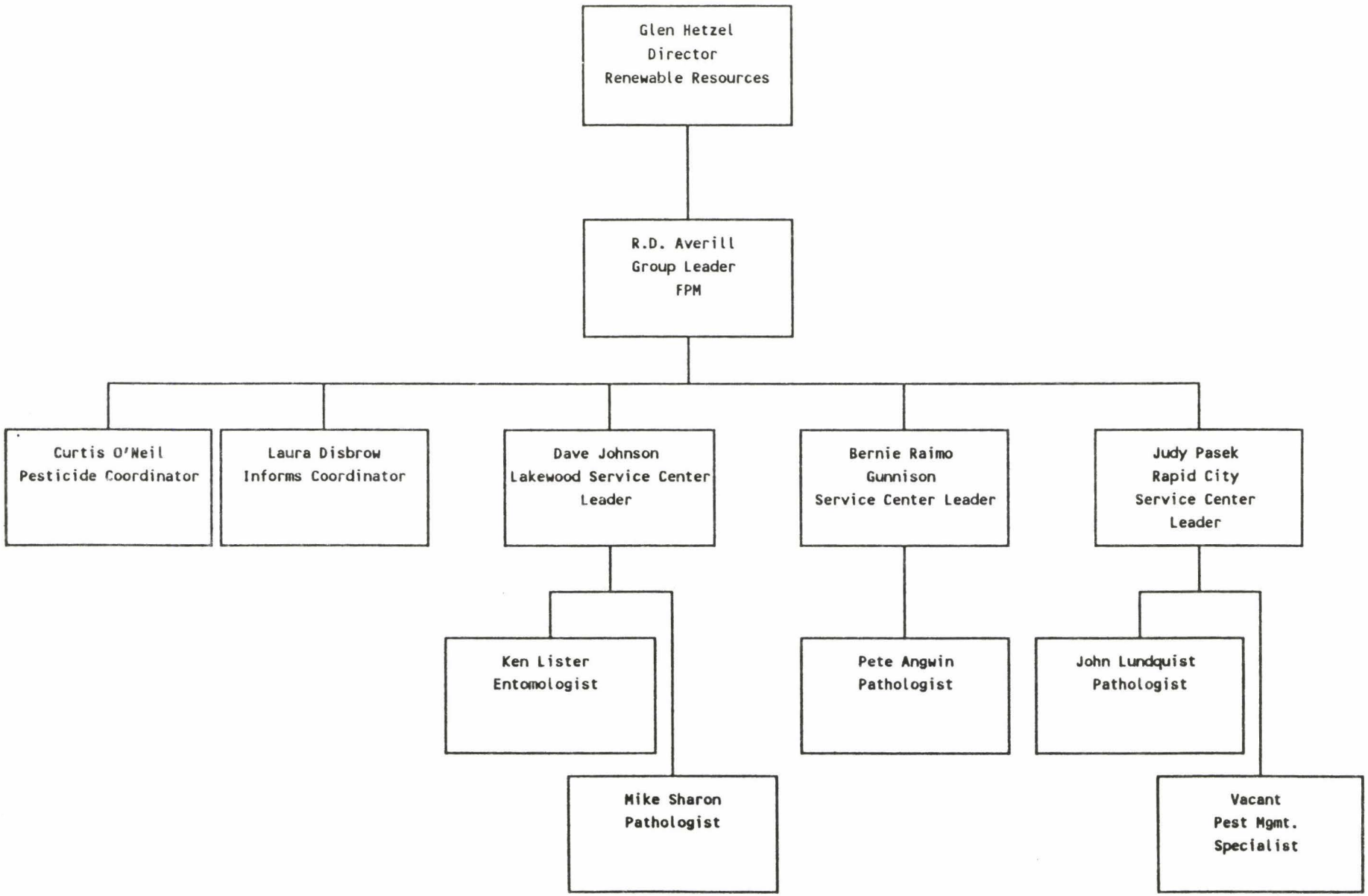
FOREST PEST MANAGEMENT ORGANIZATION
ROCKY MOUNTAIN REGION



INTRODUCTION

Forest Pest Management (FPM) is responsible for detection, evaluation, prevention and suppression of insects and diseases on forested Federal lands. Forest Pest Management also administers financial and technical assistance programs, which are available to State and private forest landowners through the Cooperative Forestry Assistance Act of 1978, Public Law (95-313).

REORGANIZATION

The Timber, Forest Pest and Cooperative Forestry Management unit has combined with the Range, Wildlife, Fisheries and Ecology to form a new unit, Renewable Resources. This will lend to a much stronger integration of the various biological resource functions in the Regional Office. Under the leadership of Glen Hetzel, Renewable Resources offers the opportunity to expand on the pest management role in all resource areas beyond previous capabilities. This new era promises much excitement for the future. Bob Averill is the Group Leader for Pest Management with overall Regional program responsibilities. Curtis O'Neal serves as the Regional IPM Coordinator. We welcome Laura Disbrow, Program Analyst and computer specialist who brings on board needed skills.

FOREST PEST MANAGEMENT SERVICE CENTERS

A new Service Center for Forest Pest Management has been established in Building 20 on the Denver Federal Center to provide assistance to Kansas, eastern and northwestern Colorado and southern Wyoming. Dave Johnson serves as the Service Center Leader. Ken Lister and Mike Sharon are the Center's Entomologist and Plant Pathologist, respectively.

The Gunnison Service Center is located at 216 North Colorado, Gunnison, Colorado 81230 with the Cebolla and Taylor River Ranger Districts, the Soil Conservation Service, and the Bureau of Land Management Area Office. It provides assistance to the San Isabel and Rio Grande National Forests and to cooperators west of the Continental Divide in Colorado (Figure 1). Bernie Raimo is Supervisory Entomologist and Service Center Leader in Gunnison and Peter Angwin is the Center's Plant Pathologist.

The Rapid City Service Center is co-located with the Rocky Mountain Forest and Range Experiment Station at the Forestry Sciences Lab, South Dakota School of Mines and Technology. The Service Center provides assistance to cooperators east of the Continental Divide in northern Wyoming, all of South Dakota and Nebraska. Judith Pasek is Supervisory Entomologist and Service Center Leader in Rapid City and John Lundquist is the Center's Plant Pathologist.

The three Service Centers were established to provide timely and effective FPM services to their customers. Questions concerning Center operations and requests for service can be directed to the Group Leader, FPM in the Regional Office or the respective Service Center Leaders.

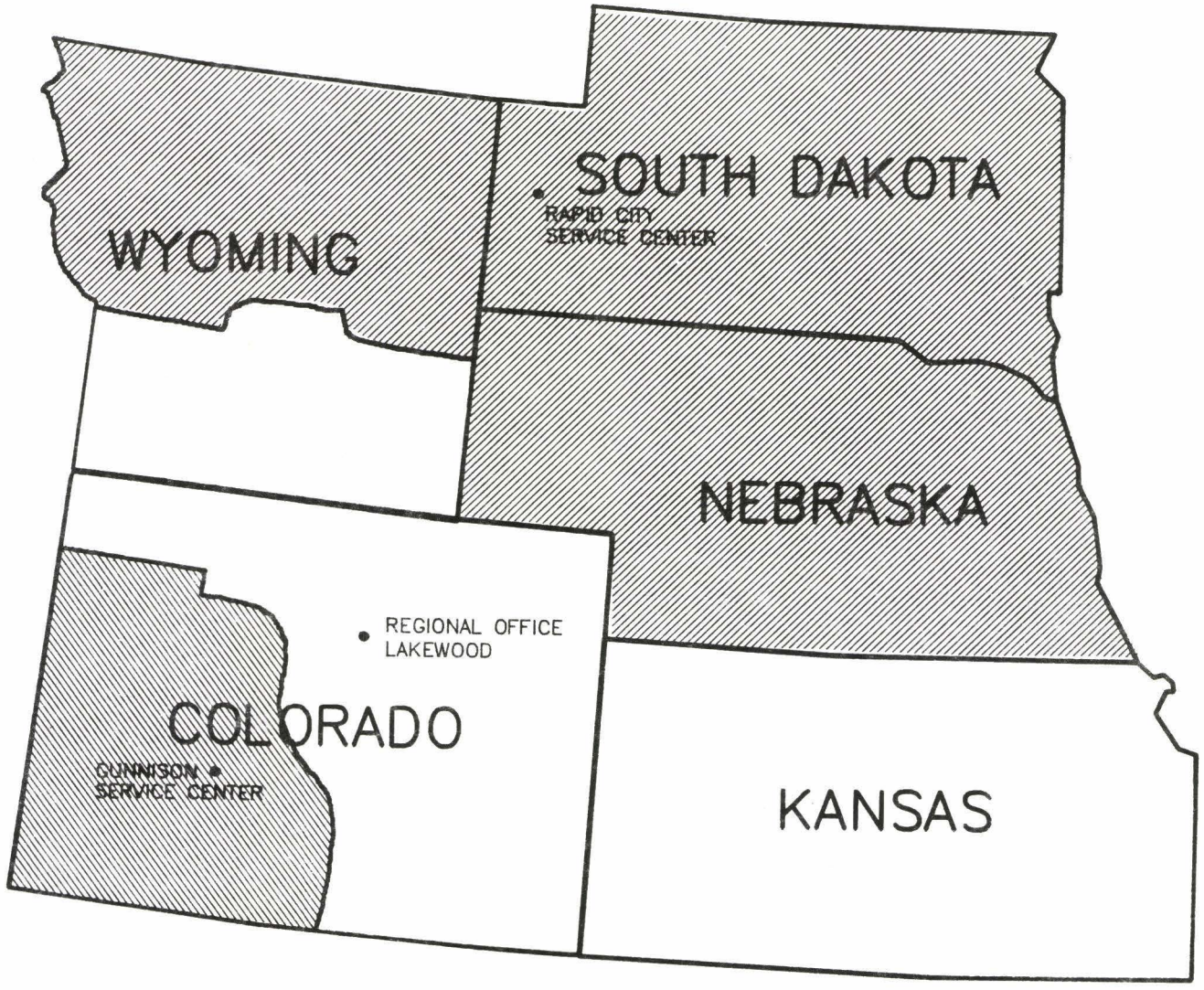


FIGURE 1. ROCKY MOUNTAIN REGION FOREST PEST MANAGEMENT ZONES.

FOREST PEST MANAGEMENT WORKSHOPS AND TRAINING

Tree Health Management Series

Two sessions on evaluating trees for hazard were held in Sioux Falls, South Dakota (May 9 and May 10). These sessions were intended to sensitize, inform and educate people who care for trees and are concerned with public safety. A total of 41 people attended.

Eight workshops were held in five states across the country. Over 245 attendees learned about risk, reasonableness and common sense in evaluating trees for hazard. The program was exhibited at the Society of American Foresters meeting in Washington, D.C., and at the International Society of Arboriculture in Toronto. More than 1,100 people were introduced to the "Tree Health Management Hazard Tree Program". Purchased videos of the program exceed 4,000. Their potential outreach into communities has been beyond our expectations.

Insect and Disease Recognition and Management

A workshop on Comandrae Blister Rust was conducted in Laramie, Wyoming (May 30-31) by the Rocky Mountain Forest and Range Experiment Station in cooperation with Forest Pest Management. A review of past and recent research on this disease was presented.

A two day training session on insect and disease recognition and management in the Region was held in Fort Collins, Colorado (June 6-7), and a three day session was held in Durango, Colorado (June 13-15). Thirty people attended the first session and thirteen the second. The sessions emphasized recognition, management, and treatment of major forests pests in the Region.

On May 30-31, Forest Pest Management staff units from the Rocky Mountain and Northern Regions and the Rocky Mountain Station held a technology transfer workshop in Laramie, Wyoming, to review information on the status of comandra blister rust and management of infested lodgepole pine stands. During the workshop, the results of 10 years research on comandra blister rust in the Rocky Mountains were presented to about 40 forest and university participants from 3 Regions. An opportunity was also provided to use several computer programs that project the effects of rust damage on stand yield. Each of the participating Regions was given a copy of the slide program illustrating the biology and epidemiology of comandra blister rust and how to evaluate its impacts at the tree and stand levels.

INSECT AND DISEASE CONDITIONS IN BRIEF

In 1989, aerial surveys were conducted on the Rio Grande National Forest and the Grand Mesa, Uncompahgre and Gunnison National Forests in Colorado and on the Black Hills National Forest in South Dakota. Data for acres affected by mountain pine beetle and western spruce budworm (Tables 1 & 2) were developed from these surveys along with some ground reconnaissance.

TABLE 1. ESTIMATES OF DAMAGE CAUSED BY MOUNTAIN PINE BEETLE BASED ON AERIAL AND GROUND SURVEYS IN REGION 2.

State	1989 Acres Affected	1990 Acres Affected	1990 Volume[1] Killed	1990 Number Of Trees Killed
Colorado	12,000	9,710	128	7,700
South Dakota	2,400	6,720	201	12,060
Wyoming	820,000	8,200	204	12,230

[1]Volume in thousand cubic feet of timber

TABLE 2. ACRES OF AERIALLY-DETECTED DEFOLIATION CAUSED BY WESTERN SPRUCE BUDWORM IN REGION 2.

State	1989	1990
Colorado	52,000	52,000
Wyoming	0	8,100

Mountain pine beetle and western spruce budworm infestations are still down at a low level similar to 1989. Tree killing by mountain pine declined on the Uncompahgre Plateau on the Norwood Ranger District, Medicine Bow National Forest. Douglas-fir beetle decreased on the Colorado Front Range but remains a concern to many. On the Clark's Fork Ranger District, Shoshone National Forest, Douglas-fir beetles emerged from the fire killed trees in the Clover Mist fire of 1988 and infested adjacent green Douglas-fir, mildly scorched by ground fire. Fir engraver beetle, (Ips pini) continues in the Black Hills where many small scattered infestations occur on both private and National Forest lands.

The gypsy moth detection trapping survey was conducted throughout the Region during 1990. No gypsy moths were caught in the detection traps in Colorado, the first such event since 1983. One moth was captured in a trap near Custer, South Dakota, at the Beaver Lake Campground. In Douglas County, Nebraska, one moth was caught in a trap at a nursery.

Generally, disease conditions were similar to or less severe in 1990 than 1989. Dwarf mistletoes continued to be the most damaging disease agents in the Region. Survey and suppression activities for lodgepole pine dwarf mistletoe have continued in Colorado and Wyoming. Forest Pest Management funded presuppression surveys on 18,184 acres on five National Forests and silvicultural control on 2,674 acres on seven National Forests. The growth regulator ethephon has been tested in several sites on lodgepole pine and ponderosa pine dwarf mistletoes for effectiveness in reducing spread of the parasite. Continued monitoring of previous tests is planned.

Extensive disease surveys were conducted in the Black Hills, where little forest pathology work has been done in the past. The major diseases found were Armillaria root disease, Comandra blister rust, western gall rust, spruce broom rust, Elytroderma needle disease, and Diplodia tip blight. The geographic pattern of distribution for Armillaria root disease was mapped. These patterns showed

that disease incidence varied from place to place, that five distinct regions of high incidence were present, and that the disease occurs in 34 of the 44 townships examined.

FPM surveyed aspen stands to determine whether site or stand parameters could be correlated with poor regeneration. This problem is becoming an increasing concern. The survey indicated that aspen stands in areas where cattle congregate, stands on dry ecotonal sites, on wet sites, on benches or in stream bottoms or with poor drainage, and small clearcuts in areas of heavy snow, will probably experience regeneration problems.

Several developed recreation sites in Region 2 have deteriorated over time by abuse, increased visitor useage, greater age of the vegetation, and insect and disease activity. The FPM staff has assisted several Forests in developing vegetation management programs by conducting comprehensive forest pest surveys at several campgrounds. At the Chapman Campground in the White River National Forest, vegetation management activities began immediately after such a pest survey. Dwarf mistletoe infected and mountain pine beetle killed trees were marked by FPM and District personnel and sold as a commercial sale. An interpretative trail was constructed as part of a basic fire training exercise in fire line construction. Seedlings were donated by a local nursery and planted by a group of 130 students from the Aspen Middle School as part of a project to offset the effects of global warming. This project was a successful example of a cooperative effort.

Canker diseases continue to plague windbreak and landscape trees throughout the Region. The increased incidence of some stress-related diseases, like Cytospora canker in Wyoming and Siberian elm canker in Nebraska, South Dakota, and Wyoming, is probably related to preceding years of drought. Siberian elm, for instance, has been so damaged by canker that this species will probably never be widely used again. The incidence of foliage diseases, vascular wilts and declines were no greater this year than last.

The use of pesticides continues as an important part of integrated pest management. Pesticides are valuable tools in forest tree nursery management and control of noxious weeds and undesirable vegetation in range management. More than 19,000 acres were treated with pesticides in 1990.

DOUGLAS-FIR COVER TYPE

Western spruce budworm: *Choristoneura occidentalis* Freeman

In Colorado, western spruce budworm acreage is estimated to be about 52,000 acres. Heavy defoliation of Douglas-fir, some Engelmann spruce and sub-alpine fir occurred again at the southern end of South Park. The Kauffman Ridge area, located east of and between Buena Vista/Salida, is the most severely damaged area of the infestation and defoliation and is predicted to be heavy again in 1991. Light defoliation is predicted for Oak Creek, which is also on the San Isabel National Forest.

A new infestation was discovered southwest of Buffalo, Wyoming. Heavy defoliation is reported. The defoliation is reported to cover an area of 8,100 acres.

Douglas-fir tussock moth: *Orgyia pseudotsugata* McDonnough

Phormone traps for Douglas-fir tussock moth (DFTM) were deployed again in 1990. The use of phormone traps was initiated in 1986 to monitor and access the DFTM populations. In 1990, 110

moths were caught which is well below the concern level. Defoliation in 1991 should not be observable in the lower South Platte River area of the Pike National Forest.

Douglas-fir beetle: *Dendroctonus pseudotsugae* Hopkins

The Douglas-fir beetle continues to occur in much of the Douglas-fir type in Colorado, but overall, it is decreasing in many sites. Most mortality is small scattered spots of 10 or less trees with some moderate sized group of 10 to 30 tree groups. The infestation along the Colorado Front Range has been underway since 1982. The overall infestation level exhibits a decline with a few areas showing slight increases or remaining at a static level.

In Northern Wyoming on the Shoshone National, Forest Douglas-fir beetle population developed in trees burned by the Clover Mist Fire of 1988. In 1990, the emerging beetles began attacking green crowned trees adjacent to the crown fire. Ground fire has weakened a lot of Douglas-fir around the perimeter of the Clover Mist Fire either by light bole scorch or root damage. At least 2,000 trees became infested with Douglas-fir beetles in the areas of Sugarloaf Mountain, Camp Creek, Upper-Reef Creek, Cathederal Cliffs, Squaw Creek, Russel Road, Pahaska Tepee. A Biological Evaluation was conducted in the fall of 1990, predicting an increased of the infestation. Salvage logging has been conducted in the operable areas of Cathedral Cliffs and Camp Creek which should help mitigate the infestation increase and spread. Baits will be used within these two areas to help mop-up the remaining population, providing they are effective.

Douglas-fir dwarf mistletoe: *Arceuthobium douglasii* Engelm.

Dwarf mistletoe occurs on Douglas-fir in the southern two-thirds of Colorado. No suppression projects were funded by FPM this year for this mistletoe species.

PONDEROSA PINE COVER TYPE

Mountain pine beetle: *Dendroctonus ponderosae* Hopkins

There are three mountain pine beetle infestation areas causing management concern in the Region. Elsewhere, mountain pine beetle is endemic. The three infestations are: 1. in the Black Hills National Forest at the southern end of the Harney Ranger District; 2. on the Uncompahgre National Forest at the north end of the Norwood Ranger District (Uncompahgre Plateau); and 3. on the Medicine Bow National Forest on the Douglas Ranger District (Cottonwood/Esterbrooke Area).

The infestation in the Black Hills has been covered with a timber sale; however, the cutting progress of the sale is very slow and subsequently the infestation is slightly building. The infestation at the Uncompahgre Plateau is finally showing signs of a decline. It has persisted for at least 13 years. It began to release and increase back in 1977. It has been a long battle for the forest managers. Considerable effort has gone into slowing the outbreak. Salvage cutting, direct control of beetles in infested trees and preventive thinning to provide host stocking regulation have been utilized. Continued harvest for host stocking regulation, such as was done in 1990, will accelerate the beetle population decline.

A small evaluation test utilizing the technique of "Spray & Bait" was installed on the Uncompahgre Plateau. Ten paired plots were used. On one plot, all trees over 8 inches dbh were sprayed with

carbaryl and the other plot received no spray. Plot size was deliminated by a 25 foot radius from plot center. The two center trees on each pair were baited with MPB Tree Baits. Paired plot comparisons and aerial videos imagery pre- and post-treatment will be used to evaluate effectiveness of the treatment. Post evaluation will be conducted in 1991.

At the Cottonwood-Esterbrook Project area, the population has returned to an increasing trend. A decrease in brood density and attack ratio occurred in 1989 probably due to severe cold weather in December 1988. Project suppression consists mostly of spot treatments of salvage logging on private lands, limited direct control of beetles in infested trees, and protective spray for high value trees near cabins and homesites. On federal lands (USFS & BLM) and on Wyoming state lands, timber sales are made to salvage and effect stocking reduction of the host to prevent continued infestation of MPB.

Pine engraver beetles: *Ips* species

The *Ips* populations continued to cause mortality scattered throughout the Black Hills. Several drought years seem to be the stimulus for the continuance of the *Ips* activity. Attempts at suppression using funnel traps baited with dianol attractant were used at Pactola Reservior and some private lands in the Black Hills. The effectiveness of this tactic is largely unknown.

Root Diseases: Armillaria sp. and Heterobasidion annosum

Southern Ute/East Archuleta Mesa Root Disease Suppression Projects-- Identification in 1989 of *Armillaria* sp. and *Heterobasidion annosum* as major root disease pathogens affecting management of mixed conifer stands on the East Archuleta Mesa on the Southern Ute Indian Reservation led to the initiation of a variety of root disease suppression projects in the area. The projects have involved a number of different agencies, including the Forest Service (Region 2 Forest Pest Management, the Rocky Mountain Forest and Range Experiment Station, and the Washington Office Methods Application Group), the Bureau of Indian Affairs (Albuquerque Area Office), and the Southern Ute Agency. This past summer (1990), aerial and extensive and intensive presuppression surveys covering an area of approximately 3,300 acres were run to determine the locations and severity of the root disease centers and to pinpoint specific areas for disease control. Stump removal and planting trials to test the efficacy of conversion to lodgepole pine, Engelmann spruce, ponderosa pine, mixed ponderosa pine/Douglas-fir, and aspen are proposed for 1991. Establishment of permanent plots to track the spread characteristics of Armillaria and Annosus root diseases and to provide validation/calibration of the newly developed western root disease model is also planned.

Disease survey of ponderosa pine in the Black Hills, South Dakota--During the last year, a roadside survey for tree diseases (especially Armillaria root disease) was conducted in the Black Hills of South Dakota. Little is known of the occurrence and distribution of diseases in this area. The aim of this survey was to characterize the occurrence and intensity of diseases and to delineate areas of high hazard. Over 200 miles of roadside forest were included in the survey and about 520 new sightings of diseases were discovered. Armillaria root disease was found in 34 of 44 townships surveyed (Figure ??). Other diseases of ponderosa pine noted were comandra blister rust, Elytroderma needlecast, western gall rust, Lophodermium needlecast, and Diplodia blight. Another part of this work involved collecting previous reports of diseases and organizing these into a list or compendium that would be useful in determining past disease conditions and trends, and from which future conditions might be predicted.

Ponderosa pine dwarf mistletoe: *Arceuthobium vaginatum* (Willd.) Presl. subsp. *cryptopodum* (Engelm.) Gill.

Approximately 20 percent of the ponderosa pine type is infested with this mistletoe in Colorado (Figure 3). Annual losses amounted to over 885,000 cubic feet. Suppression projects were funded by FPM on 344 acres of mixed ponderosa pine and lodgepole pine on the Pike and San Isabel National Forests.

Control of ponderosa pine dwarf mistletoe with ethephon--Evaluation of field tests on ponderosa pine dwarf mistletoe in the Black Forest north of Colorado Springs, Colorado, has shown that significant abscission of dwarf mistletoe shoots occurs within a few weeks after application of ethephon at rates of 2200 and 2700 ppm in water with a spreader-sticker. Examination of trees in 1990, two years following treatment, showed some development of immature shoots on all treatments, but insignificant numbers of mature shoots with fruits on all infections including controls (non-chemically treated trees). The reduction in numbers of infection with shoots observed in the controls is attributed to a combination of natural control agents including drought, branch mortality, and insects. Observations are planned for several more years to determine when mature shoots will develop on ethephon-treated trees.

LODGEPOLE PINE COVER TYPE

Mountain pine beetle: *Dendroctonus ponderosae* Hopkins

Mountain pine beetle is very low throughout the Region in the lodgepole pine type. A small infestation persists near Ute Pass on the Dillon Ranger District of the Arapaho National Forest. Suppression is being attempted by using baited funnel traps and baits to contain the spread. An intensive survey is planned in 1991 to evaluate the infestations.

Lodgepole pine dwarf mistletoe: *Arceuthobium americanum* Nutt. ex Engelm.

Approximately 50 percent of the lodgepole pine type is infested with dwarf mistletoe in Colorado (Figure 4). Annual losses on National Forest system lands alone in Colorado and Wyoming amounts to over 10 million cubic feet.

Annual plans for survey and suppression of this mistletoe have continued throughout the Region. Presuppression surveys were conducted on 18,184 acres on five National Forests. Cultural control was conducted on 2,674 acres on seven National Forests (Table 1).

Evaluations on the effects of the growth regulator ethephon on lodgepole pine dwarf mistletoe continued on the Arapaho National Forest in Colorado. Visual inspections of control plots on the Fraser Experimental Forest and at the Cutthroat Bay Campground were conducted in the summer of 1989. In separate tests, ethephon, at a rate of 2500 ppm in water with a surfactant, was applied during August with a bottle sprayer in 1983, a back pack mist blower in 1984, and a hydraulic sprayer in 1985. While more shoots were observed in 1989 than in 1988, many sprayed infections failed to resprout. It thus appears that additional spray applications may have the potential to reduce the overall number of active infections, and thereby reduce the number of subsequent new infections. Additional tests will be required to prove the above hypothesis.

Vegetation Management in Developed Recreation Areas--Forest health in developed recreation areas continues to be an ongoing concern in Region 2. In 1990, progress on vegetation management projects that were developed in past years was continued, while several new ones were initiated.

At the 83-unit Chapman Campground on the White River National Forest, vegetation management activities commenced immediately following the completion of an intensive insect and disease survey in the summer of 1989. In the following fall, trees that were infected with lodgepole pine dwarf mistletoe (Arceuthobium americanum) and killed by mountain pine beetle (Dendroctonus ponderosae) were marked by FPM and Sopris District timber and recreation personnel and sold as a commercial timber sale. As part of the design of the sale, an interpretive trial was located in the area. Cutting of the sale commenced in March 1990. Approximately 58 MBF of lodgepole pine and other sawlogs and 248 cords of products other than logs (POL) were removed. In May, a total of 3000 tree seedlings of various species were planted by a group of 130 students from the Aspen Middle School as part of a project to offset the effects of global warming. An additional 100 Engelmann spruce saplings were also planted by Forest Service personnel. The trees, donated by a local nursery, were leftover from the Earth Day celebrations. Construction of the interpretive trail was multi-financed, and took place in June as part of a basic fire training exercise in fire line construction. In September, a survey was run to assess the survival of the seedlings that were planted and the few remaining slash piles that were not taken by campers were burned.

In the fall of 1989, comprehensive insect and disease surveys were also conducted in the campgrounds of the Taylor River Canyon in the Gunnison National Forest. The results of the survey indicated that four of the campgrounds would benefit from dwarf mistletoe and hazard tree control. Management plans for the area are currently being developed and cutting in three of the campgrounds is scheduled to commence in the spring of 1991.

The year 1990 also saw the initiation of new vegetation management projects at the Twin Lakes Recreation Area of the San Isabel National Forest (Leadville District). In November, FPM personnel from the Gunnison Service Center and the Regional Office met with members of the Pike and San Isabel National Forests and Leadville District timber and recreation staffs to discuss strategies for protecting, enbancing, and rehabilitating the vegetaion in the Parry Peak and Twin Peaks campgrounds. After visiting the campgrounds, it was decided that detailed insect and disease surveys, similar to those completed at Chapman and Taylor Canyon, will be conducted in early summer, 1991. A detailed vegetation management plan will follow.

Armillaria Root Disease: Armillaria sp.

Approximately 15-20 percent of the lodgepole pines in the 71-acre Cox Park Road Plantation on the Alpine Plateau west of Gunnison, Colorado (BLM, Gunnison Area) is in various stages of decline due to effects of the Armillaria root disease. Conversion of the area to spruce is among the management options being considered.

Control of lodgepole pine dwarf mistletoe with ethephon--Evaluations on the effects of the growth regulator ethephon on lodgepole pine dwarf mistletoe continued on the Arapaho National Forest in Colorado. Visual inspections of control plots on the Fraser Experimental Forest and at the Cutthroat Bay Campground were conducted in the summer of 1989. In separate tests, ethephon, at a rate of 2500 ppm in water with a surfactant, was applied during August with a bottle sprayer in 1983, a back pack mist blower in 1984, and a hydraulic sprayer in 1985. While more shoots were observed in 1989 than in 1988, many sprayed infections failed to resprout. It thus appears that additional spray applications may have the potential to reduce the overall number of active infections, and thereby reduce the number of subsequent new infections. Additional tests will be required to validate the above hypothesis.

TABLE 3. ACRES OF PRESUPPRESSION SURVEYS AND SUPPRESSION PROJECTS FUNDED BY FPM AND CONDUCTED IN 1990 FOR DWARF MISTLETOE ON FEDERAL LANDS, MOSTLY IN LODGEPOLE PINE TYPE.

	Presuppression Survey Acres	Suppression Project Acres
National Forest		
Grand Mesa, Uncompahgre & Gunnison	0	200
Arapaho & Roosevelt	3,100	670
Routt	7,000	500
Pike & San Isabel	2,604	344
Shoshone	0	180
White River	1,180	410
TOTALS	18,184	2,674
Department of Interior		
BIA - Colorado	2,110	160
BIA - Wyoming	0	270
BIA - Southern Ute	2,000	74
TOTALS	4,110	504

ENGELMANN SPRUCE COVER TYPE

Spruce beetle: *Dendroctonus rufipennis* (Kirby)

Spruce beetle is endemic in the Region; there are no known outbreaks in standing trees. Some small populations occur in spots of logging operations, road right-of-way clearings, and windthrown spots of spruce. Timely removal of infested material was recommended at several sites.

Monitoring of spruce beetles with pheromone traps--Spruce beetles were monitored in two timber sales on the White River and Arapaho National Forests. Ten funnel traps baited with Consep® lures and ten traps containing Pherotech® lures were deployed in each timber sale area. Traps were checked weekly between June 26 and August 28. Spruce beetle flight peaked between June 30 and

July 17. At Lime Creek, on the White River National Forest, about 2,900 beetles were caught in Consep®-baited traps and about 2,600 were caught in Pherotech®-baited traps. At Supply Creek, on the Arapaho National Forest, about 16,200 and 24,000 beetles were caught in traps baited with Consep® and Pherotech® lures, respectively. No significant differences in attractiveness of the two types of lures were apparent when average weekly trap counts were compared. The Consep® lures were easier to load into the funnel traps.

ASPEN COVER TYPE

Aspen Regeneration Survey--In the Rocky Mountain Region, the small percentage of aspen clearcuts that fail to regenerate, or sprout and then die back, are becoming an increasing concern. Forest Pest Management surveyed a variety of aspen stands throughout the Region during the summers of 1988-1990. The main objective of the evaluation was to ascertain if there were any site or stand parameters that could be correlated with poor regeneration, in order to predict regeneration failure before harvest.

After this extensive survey, we are convinced that the factors associated with problems in aspen regeneration are complex, and not attributable to single causes. Different sets of problems occur in different areas, but some consistent factors emerge. Although aspen has broad ecological amplitude, survival and growth depend on a balance of appropriate environment, vigor of the aspen root system and sprouts, and destructive forces including disease and herbivores.

Herbivore pressure can shift the balance toward regeneration failure; for example, only 15 percent of dominant sprouts in good stands were browsed while 42 percent were browsed in poor stands. Excessive trampling and grazing can destroy shoots, draining carbohydrate reserves. Surface compaction changes water relations and contributes to root mortality. In some stands, for example, Green Ridge on Medicine Bow National Forest and Aspen Guard Station on San Juan National Forest, logs and slash apparently obstructed movement of herbivores and protected the aspen sprouts. A similar situation was observed on the Paintrock RD, Bighorn National Forest. However, research has shown that heavy slash can inhibit sprouting. Of course, exclosures provide effective but expensive protection.

Water relations have important implications for aspen survival, better stands tended to be on steeper slopes and tended to be positioned on mid to upper slopes. On wet sites, harvest of trees probably raised the water table and drowned root systems. On a hot dry site, harvest of trees probably exposed the soil and root system to higher temperatures, greater moisture loss, and earlier snow melt. Earlier leafing out and early herbivore use followed by dessication probably contibuted to decreased vigor of the root system and sprouts.

Weather patterns and events can affect aspen survival. In some areas, snow damage was more intense on smaller harvest units (5ac) than on larger units (40 ac), because the wind tended to scour the larger opening (Sandstone, Medicine Bow National Forest). Occasional drought (or other weather events) can give fungal diseases an advantage, especially if the aspen root system is established in soil that is usually quite moist (Cow Camp, Grand Mesa, Uncompahgre, and Gunnison National Forests, and Stoner Mesa, San Juan National Forest).

In summary, the results of the survey provide the following general indications. Aspen stands in areas where cattle congregate, stands on dry ecotonal sites, on wet sites, on benches or in stream bottoms or with poor drainage, and small clearcuts in areas of heavy snow, will probably experience regeneration problems.

Cooperative research with Colorado State University, Soil Conservation Service, Rocky Mountain Forest and Range Experiment Station, and the Rocky Mountain Region (Regional Office, Grand Mesa, Uncompahgre, and Gunnison National Forests; and San Juan National Forest), in the near future will include comparisons of soil series, water relations, fungal pathogens, herbivore use, and other factors. We are hopeful that additional factors useful for predicting the success of aspen regeneration can be identified.

ROCKY MOUNTAIN REGION--SUMMARY OF INSECTS IN COLORADO, KANSAS, NEBRASKA, SOUTH DAKOTA, AND CENTRAL AND EASTERN WYOMING. Prepared by Ken Lister

INSECT	HOST	LOCATION	REMARKS
A willow sawfly *Nematus* sp.	Willow	Wyoming	No significant activity reported in 1990.
Ash plant bug *Tropidosteptes amoenus*	Green ash	South Dakota	Populations were significantly decreased in 1990.
Aspen leaf beetle *Chrysomela crotchi*	Aspen	South Dakota	Defoliation was abundant in the central and southern Black Hills.
Balsam twig aphid *Mindarus abietinus*	Balsam fir	South Dakota	Top and branch kill resulted from the 1989 and 1990 infestation. The infestation was sprayed in 1990.
Birch skeletonizer *Bucculatrix canadensisella*	Birch	South Dakota	Defoliation was heavy in the central and southern Black Hills.
Blackheaded ash sawfly *Tethida cordiger*	Green ash	South Dakota	Light to moderate defoliation occurred in the northeast portion of South Dakota in 1990.
Bronze birch borer *Agrilus anxius*	Paper birch	South Dakota	This pest continued to be a major problem on ornamentals state-wide. Many nurseries are no longer selling paper birch.
Cankerworms *Alsophila pometaria* *Paleacrita vernata*	Boxelder, Hackberry, Honeylocust, Siberian elm	Kansas, South Dakota	Extensive damage occurred in southeastern Kansas on hackberry and elm trees; elsewhere, damage was low. Fall crankerworm caused 80 percent defoliation on 80 acres in Dewey County, South Dakota.
Common falsepit scale *Lecanodiaspis prosopidis*	Green ash, Hackberry, Red Mulberry	Colorado	No significant activity was observed in 1990.
Cottonwood borer *Plectrodera scalator*	Cottonwood	South Dakota	Serious damage occurred in some windbreaks following another state-wide increase.
Dioryctria moths *Dioryctria ponderosae* *D. tumicolella* *Dioryctria* sp.	Austrian pine, Pinyon pine, Ponderosa pine, Scots pine	Colorado, Nebraska, South Dakota	This pest continued to be a serious problem throughout most of Nebraska and South Dakota. *Dioryctria* sp. associated with twig beetles are causing pinyon mortality and branch die back in Southern Colorado.
Douglas-fir beetle *Dendroctonus pseudotsugae*	Douglas-fir	Colorado, Wyoming	On the Shoshone National Forest in Wyoming, beetles spread from trees blackened by the 1988 Clover Mist Fire to nearby scorched and green trees. About 2000 trees were infested in 1990 at Sugarloaf Mountain, Camp Creek, Upper-Reef Creek, Cathedral Cliffs, Squaw Creek, Russell Peak, and Pahaska Tepee. The epidemic is expected to continue to increase in 1991. Douglas-fir beetle is generally decreasing in Colorado, but scattered infestation spots still occur along the Colorado Front Range.

Elm calligrapha *Calligrapha scalaris*	Siberian elm	South Dakota	Heavy defoliation occurred in the southern third of the state, primarily in windbreaks.
Elm leaf beetle *Pyrrhalta luteola*	American elm, Siberian elm	Kansas, Nebraska, South Dakota	Several windbreaks in western Kansas were severely damaged, but populations were normal throughout the rest of the state. Moderate defoliation occurred throughout most of Nebraska and South Dakota. Severe defoliation occurred in Yankton, South Dakota.
European pine sawfly *Neodiprion sertifer*	Pine	Kansas	Damage increased considerably in eastern Kansas. Scots pine in Christmas tree plantations was hit especially hard and most growers applied chemical controls. The insect moved west, but damage was still light in western Kansas.
Gypsy moth *Lymantria dispar*	Hardwoods	Colorado, Nebraska, South Dakota, Wyoming	In Colorado, gypsy moth was first caught in 1984 in traps. The following areas are now considered to be eradicated: Limon, Colorado Springs, Rosita, Boulder, Fort Collins, Lakewood, and Rocky Mountain National Park. No moths were caught in traps, the first such event since 1984. In Nebraska, gypsy moth also appeared to be down in 1990; only 1 moth was caught at a nursery in Douglas County. Egg searches and mass trapping were used in 1989 following discovery of egg masses on nursery stock believed to have been shipped from Pennsylvania. One moth was caught in Yellowstone Park, Wyoming. In South Dakota, 1 moth was caught in a survey trap at the Beaverlake Campground near Custer and 2 moths were detected in delimitation traps in Keystone. No moths were detected in the delimitation survey block around the Mt. Rushmore KOA Campground.
Hackberry galls *Pachypsylla celtidismamma* *P. celtidisversicula*	Hackberry	South Dakota	Blister and nipple gall damage was down in 1990, being virtually unnoticeable.
Honeysuckle aphid *Hyadaphis tataricae*	Honeysuckle	South Dakota	Damage continued state-wide.
Lilac borer *Podosesia syringae*	Green ash, Lilac	Nebraska, South Dakota	This pest continued to be a problem in young ash trees and lilac in windbreaks and ornamental plantings.
Mountain pine beetle *Dendroctonus ponderosae*	Limber pine, Lodgepole pine, Ponderosa pine	Colorado, South Dakota, Wyoming	Mountain pine beetle in ponderosa pine continued to be the most severe in Region 2. In lodgepole pine, mountain pine beetle was endemic. In Colorado, an outbreak on the Uncompahgre Plateau decreased in 1990, but remained a problem. Populations in South Dakota were low except for an epidemic in the area between Bear Mountain and Green Mountain in the Black Hills.

			In Wyoming, an outbreak continued in the northern portion of the Medicine Bow National Forest at Laramie Peak. The infestation increased, causing an increase of tree mortality in 1990. It is estimated the infestation area is 11,000 acres.
Pandora moth *Coloradia pandora*	Ponderosa pine	South Dakota	A small outbreak was detected in the southern Black Hills in 1989 and second-year larvae caused noticeable defoliation. Defoliation was less in 1990.
Pine engraver beetle *Ips pini*	Ponderosa pine, Jack pine	Colorado, Nebraska, South Dakota, Wyoming	Infestations continued to be abundant in ponderosa pine throughout most of the Black Hills in South Dakota and Wyoming. Pheromone traps effectively reduced outbreaks at recreation sites near Pactola Reservoir and Sheridan Lake.
Pine sawfly *Neodiprion autumnalis*	Ponderosa pine	South Dakota, Wyoming	Heavy defoliation was detected between Spearfish and Belle Fourche, at Ft. Meade, and in Wind Cave National Park along the eastern edge of the Black Hills in South Dakota and totalled about 4,000 acres. About 85,000 acres were heavily to severely defoliated generally east of Gillette, Wyoming. Affected trees tended to be open-grown and on poor sites.
Pine tip moths *Rhyacionia bushnelli* *Rhyacionia frustrana*	Austrian pine, Pinyon pine, Ponderosa pine, Scots pine	Colorado, Kansas, Nebraska, South Dakota	Damage was light in Christmas tree plantations and nurseries where chemical control is often used. Young pines in windbreak and landscape plantings continued to be damaged throughout the plains and in metro areas of Colorado. Low populations of Nantucket pine tip moth were reported in south central Kansas. Pine regeneration in the southern Black Hills of South Dakota was heavily damaged.
Pinyon pitch-nodule moth *Retinia arizonensis*	Pinyon pine	Colorado	No damage was reported in 1990.
Roundheaded pine beetle *Dendroctonus approximatus*	Ponderosa pine	Colorado	Populations continued on the Uncompahgre Plateau in conjunction with mountain pine beetle and western pine beetle.
Spruce beetle *Dendroctonus rufipennis*	Engelmann spruce	Colorado, Wyoming	In Wyoming on the Shoshone National Forest, beetles were abundant in windthrown trees, thus posing a threat of infestation to adjacent green spruce. In Jefferson County, Colorado spruce beetle are infesting spruce where development disturbances were associated with suburban development.
Tent caterpillars *Malacosoma americanum* *M. californicum* *M. disstria*	American plum Chokecherry Hardwoods	Colorado South Dakota	Eastern tent caterpillar caused nearly complete defoliation of fruit trees and some shelterbelts in South Dakota. Western tent caterpillars were not a problem in Colorado in 1990.

Twig beetles *Pityophthorus* sp.	Pinyon pine	Colorado	Twig beetles in association with dioryctria moths are causing mortality and branch dieback in Southern Colorado.
Ugly nest caterpillar *Archips cerasivorana*	Chokecherry	South Dakota	Populations are down, but remained a problem in shelterbelts along the Missouri River in Central South Dakota.
Walnut caterpillar *Datana integerrima*	Pecan Walnut	Kansas	Defoliation damage was severe in the Eastern part of the state, being greater than anyone can remember.
Western pine beetle *Dendroctonus brevicomis*	Ponderosa pine	Colorado	Some populations of western pine beetle are still associated with roundheaded pine beetle and the mountain pine outbreak on the Uncompahgre Plateau.
Western spruce budworm *Choristoneura occidentalis*	Douglas-fir, Engelmann spruce, Subalpine fir, White fir	Colorado, Wyoming	Western spruce budworm remains low in Colorado except for a small infestation of 52,000 acres at Kauffman Ridge on the San Isabel National Forest where defoliation was again heavy in 1990. In Wyoming, defoliation was heavy southwest of Buffalo. The 8,100 acre infestation is mostly on Bureau of Land Management Lands.
White pine weevil *Pissodes strobi*	Colorado blue spruce	Colorado	White pine weevil damage to spruce leaders continued at a static level in south and central Colorado.

ROCKY MOUNTAIN REGION--SUMMARY OF DISEASES IN COLORADO, KANSAS, NEBRASKA, SOUTH DAKOTA, AND CENTRAL AND EASTERN WYOMING. Prepared by John E. Lundquist

DISEASE	HOST	LOCATION	REMARKS
STEM AND BRANCH DISEASES			
Comandra blister rust *Cronartium comandrae*	Lodgepole pine	Colorado, Wyoming	Most heavily infested areas were Wind River Ranger District, Shoshone National Forest, WY, and Laramie Ranger District, Medicine Bow National Forest, WY. A survey at Wind River Ranger District showed disease incidence to vary from 40% at the stand edge to 5% 12 km inside the stand. At Laramie Ranger District, disease incidence varied from 27 to 35%. The disease is present in northern Colorado and western South Dakota, but causes no significant damage.
Dwarf mistletoes *Arceuthobium americanum*	Lodgepole pine	Colorado, Wyoming	Dwarf mistletoes cause the greatest disease losses in Region 2. Losses equal at least 10 million cu. ft. annually. In Colorado, 50% of the lodgepole pine type is infected. Forest Pest Management funded presuppression surveys on 18,184 acres on five National Forests and silvicultural control on 2,674 acres on seven National Forests.
Arceuthobium douglasii	Douglas-fir	Colorado	Occurs mostly in the southern two-thirds of the state. No suppression projects were funded by Forest Pest Management in 1990.
Arceuthobium vaginatum subsp. *cryptopodum*	Ponderosa pine	Colorado	Losses amount to 885,000 cu. ft. annually. In 1990, suppression projects funded by Forest Pest Management were conducted on 344 acres in 2 national forests. This mistletoe also caused light to severe problems in the Southern Ute Indian Reservation.
Arceuthobium divaricatum	Pinyon pine	Colorado	No significant activity reported.
Western gall rust *Endocronartium harknessii*	Lodgepole pine, Ponderosa pine	Colorado, Nebraska, South Dakota, Wyoming	Widespread throughout Region 2. Mostly low to moderate incidence, but heavy in some spots. During 1990, this disease was noted on the Arapaho, Roosevelt, Bighorn, Black Hills, Nebraska, Medicine Bow, and White River National Forests. Impact is unknown.
White pine blister rust *Cronartium ribicola*	Limber pine	Wyoming	Moderately severe outbreak occurred at Tensleep Canyon, Bighorn National Forest.
Black knot *Apiosporina morbosum*	Chokecherry	South Dakota	Numerous shelterbelt plantings in north central South Dakota are badly infected.
Poplar shoot blight *Venturia macularis*	Cottonwood	South Dakota	Several shelterbelts were infected.
Ash heartrot *Perenniporia fraxinophola*	Green ash	South Dakota	This disease is becoming more common in campgrounds and declining woody draws that are being grazed.

CANKER DISEASES			
Botryodiplodia sp.	Juniper	Kansas	Incidence increased in the eastern part of Kansas and appeared to be spreading westward (a total of 200 acres is involved).
Botryosphaeria stevensii	Eastern redcedar, Rocky Mt. juniper	Kansas, Nebraska	Common in windbreaks and landscape plantings, but less severe in 1990 than 1988/9.
Cytospora canker Cytospora spp.	Aspen, Birch, Cherry, Colorado blue spruce, Cotoneaster, Lilac, Mt. ash, Rose, Russian olive	Colorado, Kansas, Nebraska, South Dakota, Wyoming	Occasionally reported on blue spruce in windbreaks and landscape plantings in all states of Region 2. Unusually common and damaging on hardwoods in Wyoming and South Dakota during the past year. Reported to be present and damaging in Nebraska, but not unusually common.
Russian olive canker Phomopsis sp., Tubercularia sp. or Lasiodiplodia sp.	Russian olive	Kansas, Nebraska, South Dakota, Wyoming	Diseases caused by these fungi were especially severe in South Dakota and eastern Kansas during 1990. In other states, its status was not noted to be different than previous years.
Siberian elm canker Botryodiplodia hypoderma Tubercularia ulmea	Siberian elm	Colorado, Nebraska, South Dakota, Wyoming	Elm decline continued to be severe in eastern Wyoming; northern, western, and southwestern Nebraska; and southern and western South Dakota.
Thyronectria canker Thyronectria austro-americana	Honeylocust	Colorado, Kansas, Nebraska, South Dakota, Wyoming	Widespread in windbreaks and landscape trees. In South Dakota, the disease was especially severe in Hot Springs. In Kansas, about 100 acres of windbreaks were affected in the western part of the state. In Nebraska, it occurred throughout the state, but was not considered threatening.
ROOT DISEASES			
Annosus root disease Heterobasidion annosum	Ponderosa pine, White fir	Colorado, Nebraska	Aerial and ground surveys for Annosus and Armillaria root diseases were conducted on 3300 acres in mixed conifer stands on the Southern Ute Indian Reservation.
Armillaria root disease	Engelmann spruce, Lodgepole pine, Ponderosa pine, Subalpine fir, White fir	Colorado, South Dakota, Wyoming	In South Dakota, several new disease sites were found in the Black Hills National Forest. In southeastern Colorado, an additional 500 affected acres were reported during 1990 on the Southern Ute Indian Reservation. Between 15 and 20% of the Lodgepole pines were reported showing symptoms in a 71 acre plantation near Gunnison.
Black stain root disease Leptographium wageneri (=Ceratocystis wageneri)	Pinyon pine, Ponderosa pine	Colorado	Continues to occur on ponderosa pine in interior portions of Colorado and on pinyon pine in the southwestern corner of the state.
FOLIAGE DISEASES			
Anthracnose Gnomonia leptostyla	Walnut	Kansas	Reported in eastern Nebraska, but the disease was less severe in 1990 than in previous years.

Apiognomonia veneta (=Gnomonia platani)	Sycamore	Colorado, Kansas, Wyoming	Severe in Kansas where 100 acres were affected in the northern part of state. Widespread in Nebraska, but not unusually severe. In Colorado, it was reported at locations in the southeastern and southwestern parts of the state.
Brown spot needle blight Scirrhia acicola	Scots pine	Kansas, Nebraska	No significant activity reported.
Cedar apple rust Gymnosporangium juniperi-virginianae	Apple species, Eastern redcedar	Colorado, Kansas, Nebraska, South Dakota, Wyoming	Occasional occurrence in Kansas and Wyoming. Widespread in Nebraska, especially in the eastern part of state but intensity during 1990 was lower than usual. In South Dakota, apple leaves were severely spotted, but the incidence of galls on cedar was much less than 1989.
Diplodia blight Sphaeropsis sapinea (=Diplodia pinea)	Austrian pine, Ponderosa pine	Kansas, Nebraska, South Dakota, Wyoming (?)	Damage increased in Kansas, especially in urban and recreation plantings where 300 acres were affected. In Nebraska and South Dakota, blight was less severe than usual. In Wyoming, one unverified report was noted.
Fire blight Erwinia amylovora	Apple species, Cotoneaster, Crabapple	Colorado, South Dakota, Wyoming	This disease occurred statewide in South Dakota, especially on cotoneaster, but intensity was not as severe as in previous years. In Wyoming, where there had been an unusually wet spring, fire blight was widespread and caused considerable damage. In Colorado, the disease was severe near Colorado Springs.
Marssonina blight Marssonina populi	Aspen	Colorado, South Dakota, Wyoming	In South Dakota, extremely heavy on susceptible varieties in shelterbelts and nurseries. In Wyoming and Colorado, low to moderate severity.
Ash rust Puccinia sparganioides	Green ash	Kansas, Nebraska, South Dakota	Present, but caused no severe problems.
Needle casts Lophodermella concolor Lophodermella montivaga	Lodgepole pine	Colorado	No significant activity reported.
Septoria leaf spot Septoria caraganae	Caragana	South Dakota	Numerous shelterbelts throughout the state were defoliated in late summer. Little long term effect is expected.
Cercospora blight of juniper Cercospora sequoiae	Eastern redcedar, Rocky Mt. juniper.	Nebraska, South Dakota	In Nebraska, disease was severe on Rocky Mt. juniper and eastern redcedar in the eastern part of the state, but less serious in 1990 than in previous years. However, the disease remains one of the major disease concerns in windbreaks. In South Dakota, the disease was occasionally found in windbreaks, but it was not unusually severe except on a few shelterbelts in the south central area.
Dothistroma needle blight Scirrhia pini	Austrian pine	Nebraska	Continued to be a problem in Christmas tree plantations and in windbreaks.
Leaf shothole Cylindrosporium sp.	Black cherry, Chokecherry	Nebraska, South Dakota	This disease was severe in Bessey Nursery in Nebraska and Big Sioux Nursery in South Dakota.

VASCULAR WILTS AND DECLINES

Dutch elm disease *Ceratocystis ulmi*	Elm species	Colorado, Kansas, Nebraska, South Dakota, Wyoming	Regionwide. In Kansas and Nebraska, the disease is a continuing problem. In South Dakota, it continued to kill the remaining elm population at a rate of 10% per year; was most severe in E part of the state. In Wyoming, it was widespread and still a problem in urban areas, especially around Casper and Wheatland. In Colorado, it was a significant problem in cities that have no active DED management program.
Oak wilt *Ceratocystis fagacearum*	Oak species	Kansas, Nebraska	In Kansas, this disease is spreading slowly eastward (50 acres of newly infected stands reported). In Nebraska, it was reported in the southern and eastern counties near the Missouri River, but the incidence or spread did not seem to be increasing.
Pine wood nematode *Bursaphelenchus xylophilus*	Scots pine	Kansas, Nebraska	In Kansas, damage was limited to two counties along the eastern border (50 acres were affected). In Nebraska, no new occurrences have been noted since 1989.
Ash decline	Green ash	Colorado	Mostly in urban areas. First recognized three years ago. Cause unknown.

ABIOTIC

Chemical damage	Many hardwood species	Colorado, Kansas, Nebraska, South Dakota, Wyoming	In South Dakota and Wyoming, herbicide damage was the most commonly reported tree disorder. In Colorado, this has been a continuing problem. In Kansas, however, incidence of herbicide damage was much less than in previous years.
Unknown decline	Ponderosa pine	Colorado	No significant activity reported.
Drought, other unknown agents	Dogwood, Black walnut, Blue spruce, Buffaloberry, Green ash, Pear, Ponderosa pine, Poplor, Russian olive, Siberian elm, Silver maple	Colorado, Nebraska, South Dakota, Wyoming	Generally, long term and secondary effects of previous dry years are appearing in trees. The increased incidence of some stress-related diseases, like Cytospora canker in Wyoming and Siberian elm canker is probably related to preceding drought conditions.
High water	Ponderosa pine	Colorado	No significant activity reported.
Winter drying injury	Aspen, Douglas-fir, Juniper, Lodgepole pine, Maple, Pinyon pine, Ponderosa pine, Siberian elm, Weeping willow	Colorado, Nebraska, South Dakota, Wyoming	Continuing problem each year. In Wyoming, this condition was especially severe in the southeastern part of the state. In Colorado, this was the most conspicuous cause of forest tree problems throughout the mountainous portions of San Carlos Ranger District of the San Isabel National Forest. In Nebraska, the condition was no more severe than usual. In South Dakota, winter drying was less severe in 1990 than in previous years.
Frost damage	Hardwoods	South Dakota	Trees in the northeast corner of South Dakota suffered from frost damage of new buds. Trees recovered by mid summer. Bur oak was most severely affected.

OTHER

Sprout dieback	Aspen	Colorado	No significant change in activity reported.
Porcupine feeding	Lodgepole pine, Ponderosa pine	Colorado, South Dakota	Reported heavy in the Black Hills National Forest.
Squirrel damage	Hackberry, Honeylocust, Maples, Ponderosa pine, Russian olive, Siberian elm	South Dakota	Reported heavy throughout state. Damaged trees up to 6 inches diameter had bark stripped on branches and boles.
Honeylocust collar rot	Honeylocust	Colorado	Widespread in urban areas of Colorado. Associated with overwatering, but causal agent is unknown.

USDA FOREST SERVICE FEDERAL CERTIFIED APPLICATOR REPORT (REFS. FSM 2150 AND FSH 2109.11) (INSTRUCTIONS ON REVERSE SIDE) (REPORT FS-2100-L)			ADMINISTRATIVE UNIT NATIONAL FOREST LANDS REGION 2 FY 1990	DATE
CATEGORY	(1) TOTAL NUMBER CERTIFIED LAST REPORT	(2) NUMBER CERTIFIED THIS FY	(3) REVOKED/ SUSPENDED CERTIFICATIONS THIS FY	(4) TOTAL CERTIFIED END OF THIS FY
(4) AGRICULTURAL	26	27	2	28
(5) FOREST	16	17	0	13
(6) ORNAMENTAL AND TURF	1	1	0	2
(7) SEED TREATMENT	0	0	0	0
(8) AQUATIC	0	1	0	1
(9) RIGHT-OF-WAY	15	38	0	36
(10) INDUSTRIAL	0	0	0	0
(11) RESEARCH	0	0	0	0
(12) NUMBER OF EMPLOYEES CERTIFIED	39	45	2	53
PREVIOUS EDITION IS OBSOLETE				FS-2100-4 (9/84)

* Most FS employees were certified through State and EPA programs as private applicators. Region 2 does not have a federal certification program.

Some applicators were certified in more than one category.

Some applicators were temporary employees and are not working at this time.

USE OF HERBICIDES IN REGION 2 FOR 1986-1990 (MAJOR HERBICIDE USES ONLY)1/

HERBICIDE	APPLICATION METHOD	1986	1987	1988	1989	1990
		Acres Treated				
2,4-D	Ground	2,857	2,592	4,623	6,688	4,902
Picloram (Tordon)	Ground	3,167	2,769	3,945	2,808	5,043
Glyphosate (Roundup)	Ground	244	387	100	384	529
Dicamba (Banvel)	Ground	295	600	469	1,337	1,385

1/ Major target species are big sagebrush, sand sagebrush, Canada thistle, leafy spurge, and various broadleaf weeds for range improvement and roadside management projects.

PESTICIDE USE IN REGION 2 IN FY 90 1/

Type of Pesticide	Chemical Used	Target Pest	Units Treated 2/
Fumigant	Methyl bromide/ Chloropicrin	Nematodes and Fusarium in nursery beds	13
Fungicide	Benomyl	Anthracnose	25
	Dodine	Shothole disease in nursery stock	6
	Zineb	Shothole disease in nursery stock	3
Herbicide	Dacthal	Nursery weed control	22
	Dicamba	Noxious weed control	3
	Diuron/Bromacil	General weed control	28
	Glyphosate/Oryzalin	Noxious weed, poison plant, nursery	8
	Glyphosate	General weed control	611
	Hexazinone	General weed control	1015 seedlings
	Imazapyr	Conifer release	1
	Metsulfuron methyl	Noxious weed control	137
	Picloram	Noxious weed control	950
	Sodium metaborate tetra	General weed control	35
	Tebuthiuron	Range/wildlife habitat improvement	636
	2, 4-D	Noxious weed control	185
	2, 4-D	Range improvement	345
	2, 4-D/Dicamba	Noxious weed control	525
	2, 4-D/Dicamba	Range management	66
	2, 4-D/Picloram	Noxious weed control	2,809
Insecticide	Bacillus thuringiensis	Mosquitos	1 acre feet
	Carbaryl	Cottonwood leaf beetle	4
	Carbaryl	Mountain pine beetle	23
	Coumaphos	Lice, mites, ticks	15,238 head of cattle
	Dimethoate	Tip moths	6
Rodenticide	Aluminum phosphide	Prairie dogs	42
	Zinc phosphide	Prairie dogs	6,342
Piscicide	Rotenone	Noxious fish	8 miles

1/ Includes use by the USDA Forest Service, other federal agencies, permittees, licensees, and grantees.

2/ Units are in acres unless otherwise indicated.

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